



New high-resolution Earth-modeling system announced

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A new Earth-modeling system will have weather-scale resolution and use advanced computers to simulate aspects of Earth's variability and anticipate changes that will critically impact the U.S. energy sector in coming years.

This multilaboratory effort will be a huge advance in our already important capabilities for Earth-systems modeling and energy-related analysis," said John Sarrao of Los Alamos National Laboratory. "Our laboratory, along with our sister institutions, has made significant contributions to Earth-systems modeling over the previous decades, but this latest contribution takes our work to an entirely new level."

After four years of development, the Energy Exascale Earth System Model (E3SM) was released to the broader scientific community in April.

The Earth, with its myriad interactions of atmosphere, oceans, land and ice components, presents an extraordinarily complex system for investigation. Earth-system simulation involves solving approximations of physical, chemical and biological governing equations on spatial grids at resolutions that are as fine in scale as computing resources will allow.

"We can focus model resolution and computer resources toward specific locations to help answer specific questions," said researcher Steve Price from the Laboratory. "For example, Los Alamos is using E3SM with focused resolution around Antarctica to improve the modeling of how ocean waters melt ice shelves — the critical process that controls the likelihood of abrupt sea-level rise."

The E3SM project will reliably simulate aspects of earth system variability and project changes that will critically impact the U.S. energy sector in the near future. These critical factors include regional air/water temperatures, which can strain energy grids; water availability, which affects power plant operations; and extreme water-cycle events (e.g. floods and droughts), which impact infrastructure and bio-energy.

"We are particularly interested in accurately assessing the risk of abrupt sea-level rise, say more than 3 feet, sometime during this century," said the Laboratory's Todd Ringler. "To accomplish this, we constructed entirely new computer models of the ocean, land-ice and sea-ice systems -- this is a huge accomplishment by the Los Alamos modeling team."

The goal of the project is to develop an earth system model (ESM) that was previously impossible because of limitations in current computing technologies. A long-term aim is to use exascale computers to expand the capacity of the model. (An exascale refers to

a computing system capable of carrying out a billion billion calculations per second. This represents a thousand-fold increase in performance over that of the most advanced computers from a decade ago).

The E3SM project includes more than 100 scientists and software engineers at multiple DOE Laboratories as well as several universities; the DOE laboratories include Argonne, Brookhaven, Lawrence Livermore, Lawrence Berkeley, Los Alamos, Oak Ridge, Pacific Northwest and Sandia national laboratories.

For more information, see the [E3SM website](#).

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